REMARKS

Status of the Claims

Claims 2-5, 7-10, 13, 15, 19-48, 51-59, 63-81, and 83-109 have been withdrawn as non-elected. Claim 110 was canceled. Claims 1, 6, 11, 12, 14, 16-18, 49, 50, 60, 61, and 82 are under consideration and have been rejected.

Claims 1, 6, 11, 12, 14, 16-18, 49, 50, 60, 61, and 82 were rejected under 35 U.S.C. § 112 first paragraph, as failing to comply with the enablement requirement. Claims 1, 6, 11, 12, 14, 16-18, 49, 50, 60, 61, and 82 were rejected under 35 U.S.C. § 112 first paragraph, as failing to comply with the written description requirement.

Applicant believes that one of ordinary skill in the art would easily recognize the features of claim 1 and described in the specification. By themselves (not mixed with any other materials), the first and the second components must be emissive materials as taught in the specification (e.g., p. 83 line 16 through p. 84 line 6)—if they were not they would not be able to transfer their excitation energy to the dopant and therefore, would not be useful as host materials. In the presence of a dopant with a lower excited state energy, the first and second components do not emit light because instead, they transfer their excitation energy to the dopant, as clearly explained by the element d) iii) of claim 1. Thus, it is only in the presence of a dopant with a properly chosen excited state energy as described in the specification, that the first and second components become non-emitting. Thus, the first and second components are selected to emit no light in the presence of a dopant, which is a basic and well-known function of any host and does not require an explanation to one skilled in the art. Although this is obvious to one of ordinary skill in the art, Applicant specified this property in the element d) iii) of claim 1 for the reasons of clarity and so that the distinction of claim 1 from the prior art would become clearer to the Examiner. Thus, again, there is no contradiction: the first and second components are taught to be emissive materials indeed to be selected as hosts but, by definition, they are non-emitting in the presence of a dopant, to which they can channel their excitation energy. In case the Examiner still finds this confusing, we are adding "in the presence of the dopant" at the end of the element d) iii) of claim 1.

With respect to the second 112 rejection, Applicant believes that in the context of claim 1, the fact that the host does not emit light in the presence of a dopant would be well known to anyone skilled in the art that it does not require an explanation. This host property is included in the very definition of a host and a dopant and it is the clear intention of the host-dopant relationship. The fact that this was explained in the element d) iii) of claim 1 does not make this any less obvious and is in reality rather unnecessary for anyone of ordinary skill in the art. The specification states in numerous places (p. 4 lines 18-19; p. 11 lines 20-22; p.13 lines 2-18; p. 83 line 16 through p. 84 line 6; p. 84 lines 7-12; p. 86 lines 12-18; p. 94 lines 14-19) that the excitation energy of the host resulting from the charge recombination process in the host must be transferred to the dopant and that for this transfer to be efficient, the dopant must have a smaller bandgap (lower excited state energy) than the first and the second components of the host. Therefore, it is believed that the specification is quite clear in that the host does not dispose of its excitation energy by emitting light in the presence of the dopant but channels the energy to the dopant. Thus, in this case, the statements "transfers excitation energy to the dopant" and "does not emit light" are equivalent, because transfer of energy excludes emission of light (by that component; it does not exclude emission of light by another component, that is by the dopant, the acceptor of the energy).

Claims 1, 6, 11, 12, 14, 16-18, 49, 50, 60, 61, 82, and 110 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Aziz et al. (US Patent 6,740,429) in view of Tang et al. (US Pat. No. 5,294,870).

There are a number of reasons for why the present invention is not anticipated and is nonobvious in view of Aziz et al. First, Aziz et al disclose a mixture of a hole transporting material, such as NPB, and an electron transporting material, such as AlQ_3, that forms a luminescent layer host and not a mixture of $AlQ_3$and a pyrene derivative. Pyrene and the like disclosed by Aziz et al is clearly used as an emissive dopant and is not the non-emitting pyrene derivative as required by claim 1 of the present invention. According to claim 1, the first component pyrene derivative is a part of the <u>host</u> of the luminescent layer, which further includes the dopant "being selected to produce light from the light-emitting device" (element e)). Thus, it is clear that the host does not produce light, as stated in the element d) iii). Under typical conditions and as explained in

the specification (p. 4 lines 18-19; p. 11 lines 20-22; p.13 lines 2-18; p. 83 line 16 through p. 84 line 6; p. 84 lines 7-12; p. 86 lines 12-18; p. 94 lines 14-19), this means that the host transfers its excitation energy to the emissive dopant and thus, emits no light. This is clearly taught in the specification as noted above and readily understood by anyone of ordinary skill in the art. Therefore, this situation is radically different from the one set up by Aziz et al. In Aziz et al it is quite clear and one skilled in the art would understand that pyrene derivative is used as an emissive dopant that is responsible for device luminescence.

Let us consider this from another perspective. What is a host? A material in organic light emitting art is defined as a host largely by its function: if its function is to mediate charge recombination and transfer the excitation energy to the light-emitting dopant, then it is classified as a host material, and is distinctly different from the dopant. A material classified as a host or a host component in a luminescent layer is, by definition, non-emitting in the presence of a dopant. Elements d) iii) and e) of claim 1 clearly specifies that the dopant is the only species in the luminescent layer that emits light and the host is non-emitting.

Second, Aziz et al teach that the luminescent layer may consist of the two-component host, a hole-transporting component such as NPB and an electron-transporting component such as AlQ_3, and a dopant, that is a "fluorescent luminescent component" (col. 8, line 42): "a device wherein the fluorescent component is selected from the group consisting of ..., anthracene, ..., pyrene, ...; a device wherein the fluorescent component is selected from the group consisting of ..., and DCJTB; ..." (col. 8, lines 43-60). Later, Aziz et al teach: "illustrative examples of luminescent materials ... include ..., anthracene, ..., pyrene and the like, ...; ... DCJTB; ..." (col. 18, lines 43-47, col. 19, lines 14-15, and col. 19, line 30). Thus, Aziz et al do not teach having both pyrene derivative and DCJTB in the same device and in the same layer. Nowhere in their disclosure do they teach a 4-component luminescent layer (2-component host and two dopants). They clearly teach to use one dopant at a time in their specification and the examples. Furthermore, based on Aziz et al, one skilled in the art would never mix pyrene dopant with DCJTB dopant in the same luminescent layer of a pure-color OLED because (1) it makes no sense since it is clear that pyrene's emission will be quenched by DCJTB and (2) they understand that Aziz et al suggest using pyrene as a blue-emissive dopant for a blue-emissive host, consisting of, e.g. a

mixture of NPB and BAlq (blue-emitting analog of AlQ_3), to make a blue-emissive OLED, and DCJTB as a red-emissive dopant for a green-emissive host, such as a mixture of NPB and AlQ_3, to make a red-emissive OLED. Applicants' position is that Aziz et al is insufficient to anticipate, suggest or provide any motivation for the present invention. Thus, there is no basis for suggesting that one skilled in the art would have understood the present invention according to the teachings of Aziz et al.

Nevertheless, the Examiner takes the position that although Aziz et al failed to exemplify a luminescent region comprising AlQ_3 and both a pyrene derivative and DCJTB, "it would have been obvious to one of ordinary skill in the art at the time of the invention to have formed a layer with AlQ_3, pyrene derivative, and DCJTB, because Aziz et al teach all the components may be used in the luminescent region". The Examiner further states that since pyrene derivative and DCJTB are both taught as useful dopants it is obvious to use their mixture for the same purpose. This is incorrect on the basis of the following.

Third, it is an established law that an obvious to try situation cannot be used to reject a claim. This is a classical obvious to try situation. Let us consider the reference by Aziz et al. Combining any three materials suggested for a luminescent layer in this reference would lead to at least several thousands of various mixtures. Would they all be useful? No, by any means they would not. Can one skilled in the art predict which mixtures can be useful based on Aziz et al? Clearly, no. A great deal of effort needs to be invested in order to obtain the valuable knowledge of which mixtures are useful—this knowledge is only now slowly emerging through the works such as the present invention. By now, there are tens of thousands of organic compounds that have been shown useful in OLEDs. One cannot simply take any three compounds found useful in an OLED and combine them in a luminescent layer and expect good performance, even less so improvements, to result from it. If this were the case, we would have had a myriad of useful mixtures around already, but we do not. Very few mixtures have been proven to be useful, and even fewer have been found to be beneficial for operating lifetime of OLEDs, probably because the exact mechanism of device degradation is still unknown. Much consideration needs to be given before putting three components together into a luminescent layer and obtaining good performance in drive voltage, electroluminescence (EL) efficiency and color, and

an improvement in the operating lifetime. This is indeed the subject of the present invention, which Applicant believes is unobvious. The requirements for material selection are only shown in the present application and are nowhere present or suggested in the prior art.

Fourth, Aziz et al are silent as to the various molecular states (set forth in the element d) i) of claim 1), which pyrene or pyrene derivative can form, depending on its concentration. Since pyrene is an emissive dopant in Aziz et al, it is clear that it is not advantageous to have it aggregate because it is well known that this would drastically reduce the luminescence and change its color resulting in a useless device. However, it is precisely this property of pyrene that is advantageously made use of in the present invention, since pyrene is not used as an emitter responsible for device luminescence. Aziz et al, therefore, teach away from the present invention and they set forth a different structure. In the present invention, one must carefully consider concentration-sensitive aggregation and spectroscopic properties before using the first component such as pyrene and the like. Not knowing of or appreciating the subject of the present invention, Aziz et al fail to teach how to take into account these unobvious aggregation properties in order to set up the proper conditions for the electronic excitation energy cascade within the luminescent layer and select the proper pyrenes and the proper emissive dopants. Selection of proper conditions and luminescent layer components is clearly taught in the present invention. Therefore, Aziz et al is not only an irrelevant but also ineffective reference since it cannot be used to teach one skilled in the art how to practice the present invention and moreover, teaches away from it.

The Examiner should also note that benzo[a]pyrene is impractical as a light-emitting dopant in OLEDs, as it results in quite poor device performance because it is a poor emitter. It readily aggregates which severely quenches its fluorescence and disrupts emission color.

The Examiner takes the position that pyrene derivatives of Aziz et al and Tang et al are used for the same purpose as set forth in the present invention that is, as emissive dopants (section 8, lines 13-14). This leads us to the fifth point. The pyrene dopant of Aziz et al and Tang et al and the first component benzo[a]pyrene of the present invention are deemed to have different functions, properties, and capabilities, and therefore, purposes. Both references

intend for pyrene derivatives to function as light-emitting dopants while in the present invention the purpose for the first host component benzo[a]pyrene is entirely different (and does not obviously stem from the previously shown purposes set forth in Aziz et al and Tang et al). In the present invention, pyrene functions as a non-emitting host component per element d iii) of claim 1 (fully supported by the specification). Thus, with respect to the functions, it is in no way obvious that the material that emits light in order to improve luminescent efficiency and color in one application can be used as a non-emitting species in order to improve operating lifetime in another. A material that emits light and thus, improves color and EL efficiency in one application hardly performs the same function as the same material that is used as a non-emitting species and improves operating lifetime in another. The properties are different too because they are concentration-sensitive: the pyrene dopant of Aziz et al requires use of low concentrations, 1% or less, in order to be at its best EL efficiency (thus, its behavior is characteristic of pyrene monomer) while in Applicant's disclosure the concentrations are relatively high to promote formation of aggregate species. The capabilities are also different; first, because the concentrations are different (which leads to emission color being different and lifetime being different—there is no lifetime extension at low concentrations but there is lifetime extension at higher concentrations), and second, no one has shown before that pyrene or pyrene derivative is capable of extending operating lifetime as a first host component of the present invention. Moreover, the exact mechanism of this lifetime extension remains to be discovered. It is then quite unobvious that aggregation may be related to lifetime extension. Thus, prediction of the lifetime-extending effect was impossible until the present invention. Clearly, the present invention as set forth in claim 1 is new and unobvious and should be allowed.

Lastly, it is quite unexpected that incorporation of the first host component in a luminescent layer results in such large improvements in operating lifetime. As the Examples show, the already long lifetimes can be extended further up to 100 times, which is absolutely unprecedented. Thus, the present invention is not only unobvious but shows an unexpected result over the prior art, where such operating lifetime improvements over comparative examples combined with such long lifetimes have never been demonstrated. Neither Aziz et al nor Tang et al taken singly or in combination disclose the subject matter of

claim 1. Moreover, they do not disclose that the addition of benzo[a]pyrene at relatively high concentrations, as to promote aggregate formation, improves lifetime.

Accordingly, it is believed there is no motivation in Aziz et al for the present invention and claim 1 is unobvious in view of Aziz et al. The claimed structure provides advantages not suggested by the prior art. The advantages of the present invention clearly support applicant's position of unobviousness.

Since it is believed there is no motivation in Aziz et al for the present invention, a combination of Aziz et al and Tang et al provides no motivation of the present invention either.

Accordingly, this application is believed to be in condition for allowance, the notice of which is respectfully requested.

It is believed that these changes now make the claims clear and definite and, if there are any problems with these changes, Applicants' attorney would appreciate a telephone call.

In view of the foregoing, it is believed none of the references, taken singly or in combination, disclose the claimed invention. Accordingly, this application is believed to be in condition for allowance, the notice of which is respectfully requested.

Respectfully submitted,

Attorney for Applicant(s)
Registration No. 22,363

Raymond L. Owens/das
Rochester, NY 14650
Telephone: 585-477-4653
Facsimile: 585-477-4646
If the Examiner is unable to reach the Applicant(s) Attorney at the telephone number provided, the Examiner is requested to communicate with Eastman Kodak Company Patent Operations at
(585) 477-4656.